
TECHNICAL HANDBOOK FOR
ENVIRONMENTAL HEALTH AND ENGINEERING
VOLUME III - HEALTH CARE FACILITIES DESIGN AND CONSTRUCTION
PART 21 - DESIGN CRITERIA AND STANDARDS

CHAPTER 21-4 MECHANICAL GUIDELINES

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21-4.8 DARKROOM VENTILATION

A. Purpose

To provide guidelines for Indian Health Service (IHS) new construction, renovation, and operation of existing health care facilities in designing and equipping medical imaging darkrooms to control exposure to toxic chemicals.

B. Background

The toxic chemicals used in medical imaging darkrooms may cause dermal or respiratory diseases in exposed individuals. In each case where medical imaging staff were affected by occupational chemical exposures, safer work practices were needed and problems were found with the installation of equipment and room ventilation. Appropriate equipment installation and room ventilation are critical elements in the prevention of occupational disease in staff.

There are at least 300 agents known to cause occupational allergy, including several agents used in medical imaging. Also, there are other potentially-hazardous products used in film processing causing such health effects as dermal and respiratory irritation. These products are used in differing concentrations and combinations depending on the product brand and manufacturer.

The potential health effects from chemical mixtures and byproducts are unknown. The mixing of processor chemical components may cause the release of sulfur dioxide, another respiratory toxin. There are reports indicating that silver recovery units may be a significant source of sulfur dioxide if the filters are not changed regularly. This unit can also be a source of exposure to the processing chemicals if the lid to the recovery unit is not tightly applied and/or if the unit is not properly installed, and the solution backs up or floods the floor.

Currently, many IHS medical imaging darkrooms are cramped and poorly ventilated. Automatic processors can generate considerable heat to hasten the film development process. While the processor manufacturers specify minimum space and mechanical requirements, these design criteria are often ignored by the designers and contractors.

Current processor design requires the operator to come in close contact with the chemicals while removing and cleaning cross-over rollers and processor racks. Despite close contact with toxic chemicals, the medical imaging staff are seldom required to use personal protective equipment when performing these tasks.

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Many smaller operations do not have automixers, requiring hand mixing of solutions. This increases the potential for exposure to toxic chemicals.

C. Design Criteria

- (1) The critical elements to reduce exposure to toxic chemicals in medical imaging are proper equipment installation and adequate room ventilation. IHS staff and the architect/engineering (A/E) staff should review and verify the following design criteria:
 - a. Review designs and specifications to assure that the darkroom is ventilated at a minimum rate of 10 room air changes per hour (ACH), measured as air exhausted; under negative pressure; and that all air is exhausted directly to the outside. Sufficient make-up air must be allowed to assure proper operation of the system. If there is a possibility of accumulation of toxic vapors, i.e., if chemical tanks are located inside the darkroom, the exhaust blower should be wired to run continuously. The termination of the exhaust duct should discharge at least 8 meters (m) from any supply inlet.

In many locations, the chemical tank for the processor is located outside the darkroom in a small alcove. Unless the area is well ventilated, i.e., at least 10 ACH with no recirculation, a small slot hood exhaust system should be installed in the wall above the tank. While there are no standard designs for venting an automatic processor, the American Conference of Governmental Industrial Hygienists has design criteria for similar applications. One effective method would be to provide a slot hood with dimensions of 50 millimeters (mm) in height and as long as the processor tank is wide. The system should be capable of exhausting at a rate of 75 meters per minute at an effective distance of 150 mm from the hood, e.g., for a 800 mm (30 inches) wide processor and a flanged hood, the exhaust blower should be capable of removing at least 280 liters per second to 420 liters per second (600-900 ft³/min) of air.

In addition, the chemical replenishment tank is often located outside the darkroom. This tank may also be a source of toxic vapor release and may require a local exhaust hood similar to that described above. Leakage from this tank can be minimized by assuring that the floating lids and tight fitting covers are in place.

- b. Provisions will be made for the installation of equipment in compliance with the manufacturer's specifications. An exhaust duct must be connected to the film dryer to discharge contaminants directly to the outside. Also, this exhaust duct should be

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constructed of smooth plastic, aluminum, or galvanized iron materials equipped with an air regulator assembly to attain maximum efficiency. One manufacturer's specifications call for a negative static pressure of 0.75 mm and 1.0 mm of water to be maintained in the vent. Project planning should also include the purchase of a pitot tube and inclined manometer or other appropriate pressure measuring instrument to be used in evaluating static pressures as a part of a preventive maintenance program.

- c. Each manufacturer also provides specifications for processor space requirements. These requirements must be followed to assure minimum clearances to maintain and service the unit. Also, space requirements for silver recovery or other critical functions must be considered in the darkroom design. A particular concern is the arrangement of pipes and electrical connections to eliminate tripping hazards. Processor manufacturers may also specify approved materials for waste piping, e.g., one manufacturer prohibits the use of copper piping and recommends only galvanized iron or polyvinyl chloride materials. The Area Institutional Environmental Health staff should be consulted regarding the space and plumbing design of this area.
 - d. If the project calls for a day-light loading processor, minimum space clearances should be provided per manufacturer's specifications, and the room should be ventilated at a rate of at least 10 ACH with no recirculation.
 - e. The feasibility of specifying a processor using a glutaraldehyde-free fixer should be considered. This would eliminate one chemical that has been demonstrated to cause sensitization; however this process is a new technology that is not suitable for all single emulsion films.
 - f. The design will include the installation of a utility sink in close proximity to the automatic processor.
 - g. Provisions will be made to specify the installation of an automixer for replenishment solutions.
 - h. Provisions will be made to specify the installation of an ANSI approved eyewash station (Z358.1) in the department near the area where chemicals are mixed. An on-the-faucet eyewash unit is not acceptable if it is the same sink used to clean crossover racks because of the potential for contaminating the eyewash unit.
- (2) The processor and ventilation systems should be evaluated at least once a year to assure the absence of leaks, and to verify minimum air exchange rates and negative static pressures in the processor vent. Provisions stated in

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paragraph C., sections (1)a., (1)b., (1)g., and (1)h., must be considered for existing health care facilities. The installation of a local exhaust system described in (1)a is required if a new processor is being installed or if the darkroom is being remodeled.

D. Reference Standards

- (1) American Institute of Architects 1996-97 Guidelines for Design and Construction of Hospital and Health Care Facilities; and
- (2) American Conference of Industrial Hygienists, 1996 Publication #2091 Industrial Ventilation: A Manual of Recommended Practice.
- (3) American National Standard Institute Z358.1